

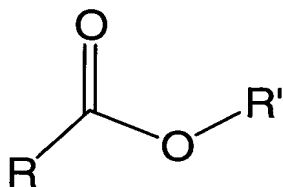
What is claimed is:

1. A composition for killing insects comprising an active compound selected from the group consisting of:

A) a bicyclic heterocyclic compound having at least 7 carbons and at most 20 carbons, wherein the bicyclic heterocyclic compound has at least one heteroatom in one of the rings;

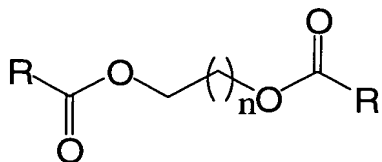
B) an ester selected from the group consisting of

i) a low molecular weight ester having the formula



wherein R is independently selected from the group consisting of a hydrogen atom and a lower alkyl group, and R' is selected from the group consisting of a hydrogen atom, an alkyl group, and a cycloalkyl group; and

ii) a low molecular weight diester having the formula:



wherein n is from about 1 to about 4; and

C) combinations thereof,

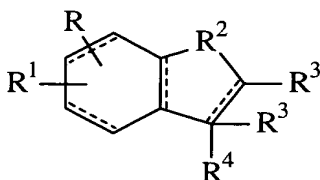
wherein the composition in its vapor phase kills insects.

2. The composition of claim 1, wherein component A) is selected from the group consisting of 9-oxabicyclo[4.3.0]nonyl, 9-thiabicyclo[4.3.0]nonyl, 9-azabicyclo[4.3.0]nonyl, 2-oxabicyclo[3.3.0]octyl, 2-oxabicyclo[2.2.2]octyl, 2-thiabicyclo[3.3.0]octyl, 2-azabicyclo[3.3.0]octyl, 7-oxabicyclo[4.1.0] heptyl, 7-oxabicyclo[2.2.1] heptyl compounds, and combinations thereof.

3. The composition of claim 2, wherein the 7-oxabicyclo[4.1.0] heptyl compound is selected from the group consisting of limonene oxide and isolimonene oxide; the 2-

oxabicyclo[2.2.2]octyl compound is selected from the group consisting of 1,8 cineoles, and the 7-oxabicyclo[2.2.1]heptyl compound is selected from the group consisting of 1,4 cineoles.

4. The composition of claim 2, wherein component A) comprises a 9-heterobicyclo [4.3.0] analog of formula:



wherein each R is independently selected from the group consisting of a hydrogen atom, a haloalkyl group, and a lower alkyl group,

R¹ is selected from the group consisting of a hydrogen atom, a haloalkyl group, and a heteroatom group,

R² is a heteroatom,

each R³ is independently selected from the group consisting of a hydrogen atom, a haloalkyl group, and a lower alkyl group, and

R⁴ is selected from the group consisting of a hydrogen atom, a heteroatom group, and a haloalkyl group.

5. The composition of claim 1, wherein component A) is selected from the group consisting of 5-oxo- 9-oxabicyclo [4.3.0] nona-1,(6),7-diene-7-carboxylic acid, (+) menthofuran, methyl 5-oxo- 9-oxabicyclo [4.3.0] nona-1,(6),7-diene-7-carboxylate, 3-(hydroxymethyl)-4,5,6,7-tetrahydrooxainden-4-ol, methyl 5-hydroxy- 9-oxabicyclo [4.3.0] nona-1,(6),7-diene-7-carboxylate, 3,6-dimethyl-3a,4,5,7a-tetrahydrocoumaran, 3,6-dimethylcoumaran, and combinations thereof.

6. The composition of claim 1, wherein component B) is selected from the group consisting of methyl propionate, methyl acetate, ethyl propionate, ethyl valerate, methyl butyrate, 1,2 propylene glycol diformate, ethyl butyrate, ethylene glycol diformate, propyl butyrate, butyl formate, *n*-propyl acetate, propyl formate, ethyl formate, butyl propionate, hexyl acetate, propyl propionate, pentyl acetate, methyl valerate, hexyl formate, heptyl formate, pentyl formate, tert-butyl formate, methyl formate, tert-butyl acetate, *iso*-propyl acetate, 1,3-propylene glycol

diformate, n-butyl acetate, cyclopentyl formate, ethyl acetate, 1,3-propylene glycol diformate, and combinations thereof.

7. The composition of claim 1, further comprising an optional ingredient selected from the group consisting of an alcohol; oils and extracts and steam distillates of natural products containing component A); racemates and diastereomers of component A) made by synthetic processes; contact insecticides; traditional carriers; propellants; and combinations thereof.

8. A method for killing insects comprising spraying the composition of claim 1 on a surface.

9. The method of claim 8, wherein the surface is an absorbent material.

10. The method of claim 9, wherein the absorbent material is selected from the group consisting of paper, cloth, woods of all sorts, plaster, drywall, hair, fur, dirt, dust, and objects composed thereof, living or non-living, indoors or outdoors.

11. A method for testing vapor phase insecticide activity comprising:

1) adding a composition to be tested for vapor phase insecticide activity to a container, wherein the container contains at least one insect, and wherein the container is configured such that the insect is not forced to contact the composition in any form other than vapor phase of the composition, and wherein the container is configured such that the composition cannot escape the container during the method.

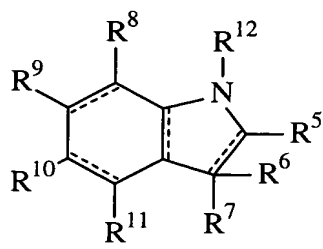
12. The method of claim 11, further comprising:

2) periodically monitoring the insect after step 1) to classify condition of the insect.

13. The method of claim 12, wherein there are at least 2 insects in the container and wherein the method further comprises:

3) determining an LD₅₀ for the composition based on amount of the composition required for 50% mortality at a specified time.

14. A heterobicyclic compound of formula:



wherein R^5 is selected from the group consisting of a hydrogen atom, a lower alkyl group, and a haloalkyl group;

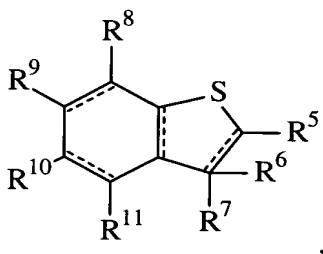
R^6 is selected from the group consisting of a hydrogen atom, a lower alkyl group, and a haloalkyl group;

R^7 is selected from the group consisting of a hydrogen atom, a heteroatom group, a lower alkyl group, and a haloalkyl group;

R^8 , R^9 , R^{10} , and R^{11} , are each independently selected from the group consisting of halo, a hydrogen atom, a heteroatom group, a haloalkyl group, and a lower alkyl group; and

R^{12} is selected from the group consisting of a hydrogen atom and a lower alkyl group, wherein when R^{12} is a hydrogen atom, both rings are saturated, and R^8 , R^{10} , and R^{11} are hydrogen atoms, then either R^6 and R^7 are both not methyl groups or R^9 is not a methyl group.

15. A heterobicyclic compound of formula:



wherein R^5 is selected from the group consisting of a hydrogen atom, a lower alkyl group, and a haloalkyl group;

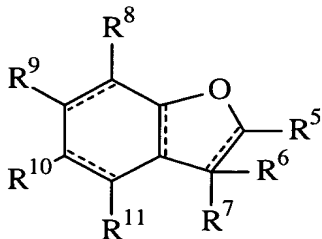
R^6 is selected from the group consisting of a hydrogen atom, a lower alkyl group, and a haloalkyl group;

R^7 is selected from the group consisting of a hydrogen atom, a heteroatom group, a lower alkyl group, and a haloalkyl group; and

R^8 , R^9 , R^{10} , and R^{11} , are each independently selected from the group consisting of halo, a hydrogen atom, a heteroatom group, a haloalkyl group, and a lower alkyl group; and wherein

when R^8 , R^{10} , and R^{11} are hydrogen atoms, then either R^6 and R^7 are both not methyl groups or R^9 is not a methyl group.

16. A heterobicyclic compound of formula:



wherein R^5 is selected from the group consisting of a hydrogen atom, a lower alkyl group, and a haloalkyl group;

R^6 is selected from the group consisting of a hydrogen atom, a lower alkyl group, and a haloalkyl group;

R^7 is selected from the group consisting of a hydrogen atom, a heteroatom group, a lower alkyl group, and a haloalkyl group; and

R^8 , R^9 , R^{10} , and R^{11} , are each independently selected from the group consisting of halo, a hydrogen atom, a heteroatom group, a haloalkyl group, and a lower alkyl group; and with the provisos that:

when R^6 , R^7 , and R^9 are all hydrogen atoms, then at least one of R^8 , R^{10} , and R^{11} is selected from the group consisting of halo, a haloalkyl group, and a heteroatom group;

when R^7 is a hydrogen atom and R^6 and R^9 are both methyl groups, then at least one of R^8 , R^{10} , and R^{11} is selected from the group consisting of halo, a haloalkyl group, and a heteroatom group; and

when R^6 is a hydrogen atom and R^7 and R^9 are both methyl groups, then at least one of R^8 , R^{10} , and R^{11} is selected from the group consisting of halo, a haloalkyl group, and a heteroatom group.